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Time Travel in a Gödelean System

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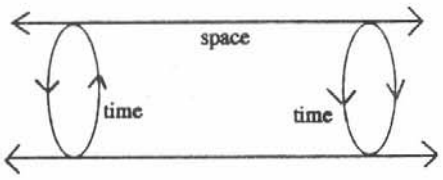


Spacetime

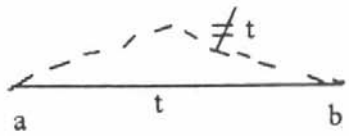
Kurt Gödel has claimed that time travel is physically possible not only into the future, but also into the past. Future time travel has already been shown to be possible by Einstein's Theory of Relativity. This involves simply moving quickly and thus aging slowly. Gödel claims that it is also possible to travel backwards in time. His claim is based on his solutions to the field equations of General Relativity. These equations and their solutions allow for the existence of closed causal chains, but so far have not been shown to entail them. A closed causal chain is like a loop in which the starting point and the end point are the same. This differs from our instinctual perception of time as a line going straight away in one direction. The idea is that by traveling forward in time far enough one will eventually arrive in the past. This travel takes place along the "backwards" part of the chain (Horwich, 111). There is no precise point at which you enter the past, but it is possible to get there.

Of course, most people would be quick to deny time travel as a real possibility. Indeed there are many arguments against Gödel and the way he interprets his equations. Paul Horwich, in *Asymmetries in Time,* claims that Gödel's idea can be defended from the arguments against it. By defending Gödel, he concludes that the possibility of time travel is possible, at least in a limited way. I will outline the arguments against Gödel and Horwich's responses to these, then attempt to ascertain whether or not Horwich succeeds at convincingly showing that time travel is indeed a possibility.

There are two general methods of attacking Gödel. The first is to claim that time travel is a logical impossibility, and thus it should be regarded as a computational oddity and thereby ruled out. This is done all the time in mathematics. For example, when solving for the length of the hypotenuse of a right triangle, we use the equation $a^2 + b^2 = c^2$. So if $a^2 + b^2 = 4$, then $c^2 = 4$. Thus c can be either 2 or -2. But we don't even pause long enough to consider our actions when we immediately throw out -2. We know it is impossible for the side of a triangle to have a negative length. In a similar fashion, according to this argument we should eliminate all solutions to a set of equations which state that time travel is possible. This is the essence of the first argument against Gödel. It seems to say that time travel is impossible because it is logically impossible, which is a tautology. Horwich does not try to refute this argument, but rather works on the second argument. In defending Gödel against the other arguments, Horwich is essentially doing all he can to argue against this first argument, though he doesn't explicitly say that he is attacking it. The only way to refute this argument is to show that time travel is not a logical contradiction. This is done by showing that it is indeed a possibility. If someone says *P* is false because it is false, all you can do is prove that it is not false. You can't just say, "No, it's not."

The second general argument is based on the idea that if time travel were possible, all sorts of contradictions in our universe would arise. There are four parts to this argument. Horwich quickly eliminates the first three, and spends most of his time on the fourth.

The first part of the argument states that time travel is impossible because it implies that you go from a temporal point A to temporal point B in an amount of time different from the temporal "distance" or duration of the interval. For example, the amount of time your trip takes is less than the amount of Earth time that passes while you are gone.



For instance, supporters of this argument would say that it is impossible to go 500 years in fifteen minutes, but according to the Theory of Relativity, this is indeed possible. The Theory of Relativity has already solved this alleged paradox with the concept of relative time frames. By showing that time is relative to where you are, 500 years and fifteen minutes can take on new meanings in different time frames. Because time is local, according to Relativity Theory, there is no way of telling if two clocks at a distance are keeping the same time, or whether two events take place simultaneously. Even if you could send a watch from one place to the other at the speed of light, you still couldn't tell if they were keeping the same time, because no matter how long the watch travels, it still keeps the same time. Or if, instead of a watch, you could send a woman on a round-trip time trip, traveling at near the speed of light, her watch would indicate that her trip took, say fifteen minutes, but upon her return to Earth, she would see that 500 years had passed (Slosson, 40). So in this case the woman is able to exist in a time 500 years later than when she left on her trip. Ordinarily this is impossible since the human life span isn't that long. In any case, it only took her fifteen minutes to get there, not 500 years. Our current technology doesn't allow people to travel at near the speed of light, though. Theoretically, however, it is possible to traverse a temporal distance in less than the duration of the interval, so this argument against Gödel is not valid.

The second part of the argument appeals to Leibniz's law of the indiscernability of identity. This law states that states that identical things must have identical properties. Thus, using Horwich's example (p. 115), assume Charles has a beard at one point in time and not at another later time. Then if Charles travels back to the time when he had a beard, he would not have the same properties as the bearded Charles existing at the previous time, so by Leibniz's law, Charles is not the same person when he is bearded as when he is not. This is a contradiction because Charles is Charles regardless of facial hair patterns. By contradiction then, time travel must be impossible given that Leibniz's law holds.

Horwich points out that Leibniz's law encounters this same problem even if no time travel is involved. Is Charles with a beard in 1990 the same person as he was in 1960 when he did not have a beard? No, he is not, according to Leibniz's law. But we know that Charles is Charles regardless of facial hair. Secondly, Horwich shows that this argument against time travel can be overcome by indexing the Charles in respect

to Charles-time (time as related to Charles). So Charles-having-a-beard-in-1990-in-1960 is a property of Charles, and he will always have this property. By explaining that Charles' characteristics are related to what time he is in and what time he started his trip in, it can be explained that Charles is himself in both 1990 and 1960, because the properties are identical when they are indexed in time. In any case, Leibniz's law doesn't seem particularly important here because as time goes on, most things experience some changes, yet remain the same object. Cars get dirty but remain the same car, for example. Thus, this argument against time travel is rather problematic to begin with, and easily overcome.

The third argument states that if time travel were possible, then it would be possible to change the past while on your time journey. Since, according to this argument, changing the past is logically impossible, time travel is logically impossible. In arguing against this, Horwich claims that there is a distinction between "changing" the past and "influencing" the past. Thus a time traveler may influence the past, but he or she cannot change the past because that is logically impossible. Horwich attempts to explain his thoughts on why it is possible for someone to travel into the past, but not possible for that person to change the past while there. He does this by using the example of Charles and his attendance at the battle of Hastings. Horwich says that it is okay for Charles to travel back to the battle of Hastings, but not possible for him to change history. He can, however (according to Horwich), influence history, as long as he doesn't change it. To understand his position fully, I offer his words:

> It is important to see that no bizarre constraints on Charles's freedom are entailed by the supposition that he did not attend the battle. From the fact that someone did not do something, it does not follow that he was not free to do it. Consequently, from the fact that Charles was not at the battle, it cannot be inferred that if he was to travel back in time, he would not be free to do it. Laws of logic do not involve the kind of limitation on our ability to choose and act freely of which it is appropriate to give causal explanations. In particular, we are not required to explain why it is that if Charles did not attend the battle, then when he travels back in time he does not attend it. This is merely an instance of $p \dashrightarrow p$ (Horwich, 116).

Horwich seems to be saying one of two things. The first is that the reason Charles may not attend the battle is because he didn't attend the battle. If he did attend, it would logically contradict the fact that he did not attend the first time around. The second point Horwich might be making with his distinction between changing and influencing is that Charles could attend the battle but not change history; he could only influence it. Both of the methods Horwich uses to get out of the Changing the Past argument are rather problematic.

In the first case, he says not attending the battle the first time around does not entail that he wasn't free to attend it. How is this important? Is Horwich attempting to say that when Charles travels to the time of the battle, he will be free to attend the

battle, but for some reason, when he arrives he won't go? Maybe suddenly he just wants to take a nap and thus doesn't attend, so no logical contradiction occurs. This argument is discussed further in the fourth argument against Gödel, but for now we might ask firstly how it is that every time that Charles travels to the battle something comes up to block his attendance, though each time he felt free to go. Secondly, if Charles cannot attend the battle when he time-travels because he didn't the first time around, what can he do in the past? Nothing. He was not present for any of it. Whatever he does in the past is a contradiction, because he didn't do it. Even if he does something that seems to have no historical consequences, such as traveling to 1020 in order to take a nap on the top of a mountain, it is still a contradiction because he did not nap on a mountain in 1020. Thus, whatever he does in the past while on a time trip is a logical contradiction, so it seems that the argument against Gödel holds. Traveling to any point in Charles's own lifetime is also contradictory because Charles was never in existence in his present form at any point in his life, except for at the present moment, of course.

Perhaps Horwich is assuming that Charles does not attend the battle because he didn't attend the first time around, and his non-presence was recorded somehow. So any time of non-presence of Charles that wasn't recorded can be entered by Charles. Of course this is not a worthy objection, since an event doesn't have to be recorded in order to be true. Historically, Charles was not in any past prior to his own lifetime regardless of whether or not it was recorded that he wasn't. In any case, Horwich's defense of this argument against Gödel is questionable.

The fourth argument against Gödelean time travel was one that Gödel himself was concerned about. This argument is concerned with the question of why attempts to change the past always fail. Gödel used the example of returning to a point in your own lifetime and punching yourself in the nose. Others have used the example of "autofanticide," the act of returning to the time of your infancy and killing your infant self. Gödel himself found this argument so convincing that he had to argue on alternate grounds that instances of time travel to one's own lifetime are impossible. (More on this later.)

Horwich says that Gödel's concern about the punching oneself in the nose is misguided. This is because if I return to the past and don't punch myself in the nose, everything is okay. History is not changed, according to Horwich. If I do punch myself in the nose, then I must have a memory problem. I was historically punched in the nose, and simply forgot about it. So if I think I wasn't punched in the nose, and I return to my past and punch my nose, I was mistaken about not being punched. Hence everything is logically okay. History has not changed in this case either. Horwich feels that this solves the problem, but an argument based on memory failure seems very weak. Can only the memory-impaired be time travelers? How would that work? Assuming that I am not memory-impaired, when I show up for my time trip, will it just so happen that, for some seemingly reasonable reason, I cannot go? If that happens every time any non-memory-impaired person tries to time-travel, it would seem rather suspicious.

In any case, history is not based on what I remember happening, but what really happened. What if I factually was not punched in the nose and return to my past and do punch myself? This is a contradiction. One defense is to claim that in returning to

the past, I can only attempt to change history, but for various reasons these attempts always fail. This is known as bilking and is referred to later.

Horwich, however, uses a different defense. He argues that punching one's nose (and/or committing autofanticide) on a time trip is impossible for reasons other than memory failure. He says that when you attempt to place an ordinary causal chain (i.e., a series of events that we normally consider to be a linear progression) on a closed curve, difficulties arise. This is because the starting point and the endpoint (which are the same point on the closed curve) are incompatible. For example, if you kill your infant self on a trip, the endpoint is death and the beginning is aliveness. These are the same point, so something is wrong. From this, opponents of time travel conclude that closed causal chains are impossible, and thus time travel is impossible too. Horwich argues that this view assumes that all causal chains can be located along closed curves, not just a restricted class. He says that assuming that consistency conditions are placed on closed causal chains is not a remarkable assumption. All causal chains and their relations have restrictions, even in the common conception of linear, non-closed time. Thus, causal chains with contradictory beginning and ending points are impossible because of these restrictions, and we do not need to worry about "autofanticidal maniacs" or nose punchers.

The final consideration against Gödel involves "bilking." Bilking is bringing about some past event. It always fails for semantic reasons (since it is assumed that changing the past is impossible due to contradictions already discussed). But is it not strange that it always fails? A quick response to this argument is to explain the uniform failure of bilking in terms of failed attempts like gun misfirings, changes of mind and the like. Obviously for these to happen on a constant basis is problematic, and to base the nonexistence of time travel on these is not very sound. In order to attack a stronger form of this argument, Gödel constructs a more rigorous form of it. The argument that he devises does not rely on human capacities.

The argument goes as follows. If time travel is possible, men will do it into their local past. If this happens, there will be bilking attempts. These, however. will be thwarted. The regular thwarting of bilking involves a series of improbable coincidences. Therefore, if time travel is possible, certain things will occur that we have reason to believe will not in fact occur (i.e., an improbable string of unlikely occurrences, namely, constant failure of bilking attempts). So, based on this argument, we have reason to believe that time travel is impossible (Horwich, 123).

After devising this argument, Horwich attempts to defend Gödel by denying the first premise; that is to say, he denies that men will time-travel into their local past if it is permitted in spacetime. Horwich claims that the reason people will not travel to their recent past is because there isn't enough fuel to do so. After going through four objections to this and refuting them all with varying degrees of success, he concludes that time travel is possible, but not to our own history, only to the spatially distant past, which apparently requires much less fuel.

An important objection to this fuel argument is the question of what would happen if there was enough fuel, since the question of the possibility of time travel is a question of the possibility of time travel in principle anyway. It seems that there are objections that would disallow time travel other than limited fuel. Horwich

counters this by assuming that a world with enough fuel for a near round trip would be a world with many different characteristics than the world we know, so it really isn't worth talking about. Our world will never have enough fuel to allow time travel to the recent past, he seems to imply, and positing that there could possibly be is to posit an entirely different world. This seems like the example in logic where an impossibility follows from an impossibility. For example, if the moon is made of blue cheese, monkeys can fly. The moon is not made of cheese, but if it were, monkeys could fly. This is logically valid, but also quite meaningless. Horwich's refutation of the fuel argument is similar because he claims having enough fuel is a similar impossibility. He really doesn't defend his use of the fuel argument, but instead constructs a meaningless, yet logically valid statement.

In defending Gödel, Horwich has allowed that time travel into our recent past is impossible. This does not imply a non-Gödelean space-time. Hence, "...for all we know there do exist closed timelike lines, making a real possibility of closed timelike lines to the spatially distant past," concludes Horwich (p. 128). It should be noted that he does not define the spatially distant past.

Is this a significant conclusion? Yes and no. Though we are not allowed to travel to our own past, we are allowed to travel to a different point in time. Because only some causal chains are closed, only in certain cases will time travel be possible. If time is really a closed causal chain, then traveling to the past is the same as traveling to the future. We normally consider time travel to our own past impossible, and rightly so, as Horwich has stated. Concluding that time travel to the "spatially distant past" is possible is a rather vacuous claim, since he does not define the spatially distant past and we really have no conception of a past that is not our own.

To say we may not travel to our own past, but can travel to the past, implies that we can travel to a past not our own. Where can you draw that line between our past and not-our-past, presuming that all time lies on one (closed) chain? Perhaps this implies that there are different time chains coexisting in the universe, and we can travel to a point on one of these that is relatively previous to a point on our own time chain, but not to a point in the past on our own chain. In any case, it is difficult to imagine what time travel to the past is.

I agree with Horwich's conclusion that travel to the recent past is impossible, but disagree with his reasons why. His defenses of the arguments about changing the past, bilking and autofanticide are all very suspicious, and do not seem to adequately refute the arguments against time travel.

Feeling that he has refuted the arguments, Horwich goes on to claim that the real reason that time travel is impossible is because of fuel limitations. This is a silly reason to disallow time travel. There is no reason to limit an in-principle possibility with a current physical limitation. Horwich arrives at the more valid conclusion for the wrong reasons.

Bibliography

Horwich, Paul, *Asymmetries in Time.* Cambridge, MA: MIT Press, 1987.

Slosson, Edwin E., *Easy Lessons in Einstein.* New York: Harcourt, Brace and Howe, 1920.